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A BENTHIC SURVEY OF INNER BANTRY BAY

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Abstract

In February 1993 sediment samples were collected from a total of 18 stations in Bantry Harbour, Glengarriff Harbour and along the north shore of Whiddy Island. The samples were analysed for grain size, organic carbon content and the abundance of benthic infauna. The benthic infauna were identified to family level. The sediments in Bantry Harbour and Glengarriff Harbour were comprised of fine particles with typically >80% of the dry weight being in the silt/clay (<63 µm) fraction. In contrast, the sediments close to Whiddy Island contained relatively high amounts of coarser material. In Bantry Harbour a total of 53 families with 742 individuals were identified from the ten stations sampled. Of the 53 families identified, 21 were Polychaeta, 6 Bivalvia, 7 Gastropoda, 3 Echinodermata, and 16 Crustacea. A total of 31 families with 491 individuals were identified from the five stations sampled in the Glengarriff Harbour area. Of these 16 were Polychaeta, 4 were Bivalvia, 3 were Gastropoda, 1 was Echinodermata, and 7 were Crustacea. From the three stations sampled in the vicinity of Whiddy Island 47 families with 461 individuals were identified. Of these 23 were Polychaeta, 8 Bivalvia, 4 Gastropoda, 2 Echinodermata, and 10 Crustacea. In Bantry Harbour and Glengarriff Harbour cirratulid polychaetes were dominant and the benthic infaunal composition was indicative of stressed environmental conditions. In contrast, the sediments close to Whiddy Island exhibited a very healthy faunal composition with no one family predominating and high numbers of amphiuroid echinoderms were recorded from these sampling stations

Introduction

A large number of investigations of the biology and ecology of Bantry Bay have been conducted over the past 25 years. These have included investigations of the rocky shore ecology (Crapp, 1973; Cross *et al.*, 1979; Myers *et al.*, 1980; Baker *et al*., 1981), zooplankton, including the ichthyoplankton, distribution (Grainger *et al.*, 1980, 1984; Ryan, 1982; Doyle and Ryan, 1989) as well as the phytoplankton ecology (Raine *et al*., 1989, 1990). Few studies, however, have considered the macrobenthos.

Benthic organisms, and most especially the macrobenthos, are important to overall ecosystem structuring and functioning. They have very limited locomotory powers, or actually have a sessile lifestyle, and must, therefore, tolerate prevailing environmental conditions or die. This makes them very good indicators of the "health" of the system. Their taxonomy is well documented, and there is a growing body of research literature available on their responses, from the individual to the community level, to pollution and disturbance effects. For these reasons they are considered to be very useful foci in marine environmental impact assessments.

For sedimentary infauna, grain size is considered to be the most obvious correlative factor. Because of this, benthic surveys not only address the faunal components but also the sedimentary regime. Obviously, where specific and potentially toxic chemicals are involved, their persistent and accumulating levels in both the physical environment and in the tissues of ecologically im-

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portant organisms should ideally be taken into account. To this end a more multidisciplinary survey, to cover all such elements, is the ideal approach.

The processing of benthic samples in monitoring protocols is both labour-intensive and time-consuming, and the data returns tend to be slow. Sampling design, therefore, must not only consider which species to monitor but also at what level of taxonomic discrimination. Warwick (1988) hypothesised that pollution may change community composition at higher taxonomic levels (e.g. family, phyla) whereas natural variables (grain size, depth, etc.) modify it more by species replacement (within phyla). Thus, distribution of higher taxa may relate more closely to contamination gradients than species data, the latter being more complicated by the effects of confounding natural variables.

It has been shown (Warwick, 1988; Neiland, 1991) that aggregation of species to higher taxa, such as families, yields more or less the same results as when discriminated to species level and is considered sufficiently sensitive to detect pollution-induced changes. For broadscale assessment of pollution effects, initial assessment of the data at higher taxon levels can result in a considerable saving of time and cost and does not require the same expert input.

In this report the results of a benthic survey carried out in inner Bantry Bay in February 1993 are presented and discussed.

Materials and methods

Sampling was carried out in February 1993. Replicate (three) sediment samples were taken, using a hand-operated 0.025-m^2 van Veen grab, at each of the locations given in Table 1 and Figure 1. Two of the samples were retained for faunal analysis and the third for physico–chemical analyses. Faunal samples were wet-sieved through a 1-mm mesh to remove excess sediment. The residue was fixed in 9% neutrally buffered formalin and then stained with eosin.

Physico–chemical analysis

Granulometric analysis was carried out on one aliquot of each sediment sample as described by Folk (1974). A 30-ml solution of aqueous sodium hexametaphosphate (6.2 g/l) was added to 100 g of oven-dried (100°C) sediment; the mixture was made up to 1 litre with distilled water, stirred mechanically for 15 min and allowed to stand overnight. This mixture was then re-stirred and washed through a 63-µm sieve. The material that passed through the sieve was regarded as the silt–clay fraction. The remaining contents were regarded as the sand fraction. This fraction was oven-dried at 100°C and weighed and the silt–clay fraction determined by subtraction. The sand fraction was graded through a nest of sieves of 4, 2, 1.4 mm and 710-, 500-, 355-, 250-, 180-, 125-, 90- and 63-µm mesh. Each grade was weighed and the value expressed as a percentage of the total dry weight of the sample. The second aliquot of the divided sediment sample was used to quantify the organic carbon content of the deposit at each station. Organic carbon was determined using a CHN analyser.

Faunal analysis

Each faunal sample was washed with distilled water to remove excess formalin and then sorted, into the following taxonomic phyla: Polychaeta, Bivalvia, Gastropoda, Echinodermata and Crustacea. These phyla were then identified to family level using taxonomic keys as listed on page 15.

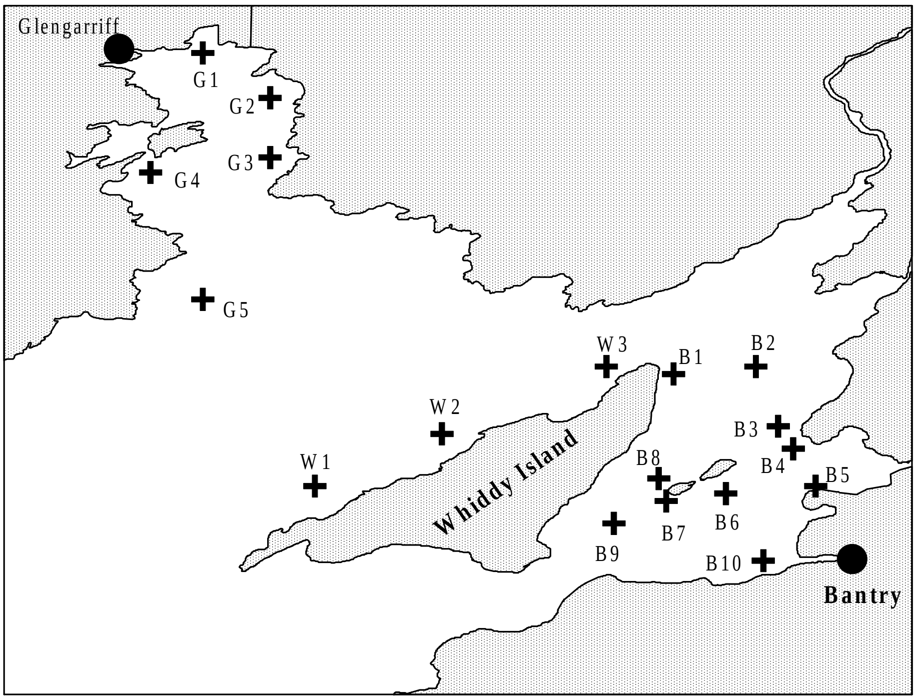

Figure 1. Location of sampling sites in inner Bantry Bay, February 1993.

Each phylum was assigned a numeric identification code as follows:

Polychaeta – 1; Bivalvia – 2; Gastropoda – 3; Echinodermata – 4; Crustacea – 5.

The replicate samples were combined for each station, so that results encompass the number of organisms/0.05 m^2.

Data analysis

The data resulting from the survey were subjected to statistical and numerical analyses using the PRIMER (Plymouth Routines in Multivariate Ecological Research) package, a suite of programmes developed at the Plymouth Marine Laboratory.

A number of community parameters were calculated using the original data matrix including:

(a) Diversity – Shannon–Weiner (H') (1949) index.
(b) Evenness – Pielou’s (1975) index
(c) Richness – Margalef ’s (1958) index

Prior to multivariate analysis the data were transformed logarithmically. Classification analysis was performed using hierarchical agglomerative clustering with the group average sorting technique (Clifford and Stephenson, 1975) and the Bray–Curtis similarity index (Bray and Curtis, 1957). Classification or cluster analysis aims to find “natural groupings” of samples such that samples within a group are more similar than samples in different groups. It is used to define site and species assemblages. A tree diagram or dendrogram represents the classification.

Results

Bantry Harbour

The results of the physico–chemical analyses are shown in Table 2 while Figure 2 presents the results of the classification analysis carried out on the granulometric data.

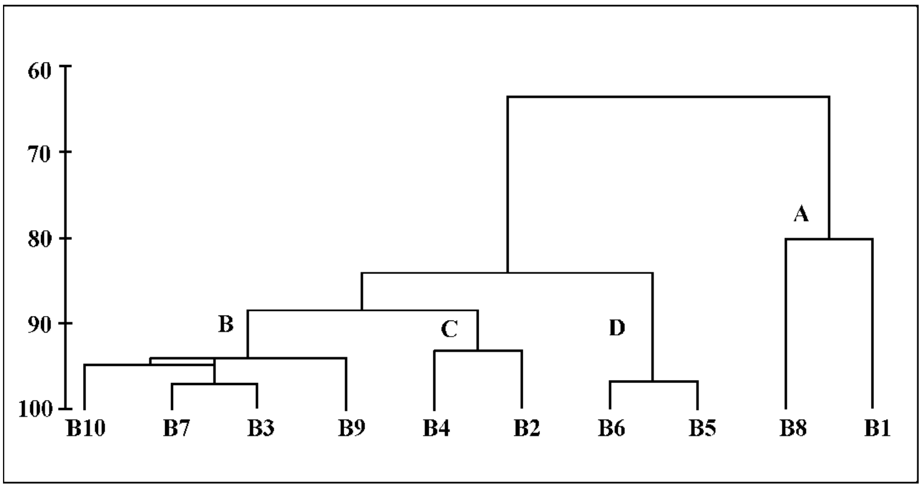

Figure. 2. Results of the classification analysis of the granulometric data from Bantry Harbour.

Four station groupings were defined:

Group	Station
A	B1, B8
B	B3, B7, B9, B10
C	B2, B4
D	B5, B6

Group A was clearly separated from the other station groupings at a much lower level of similarity. Groups B, C and D fused together at high similarity levels. Group A contained stations with sediments of a coarse nature, with a comparatively high gravel and coarse sand content. In Group B, Stations B7 and B3 fused together at a high level of similarity. These had a silt–clay content of >89%. The rest of the sediment was mostly fine sand with negligible amounts of coarse material. The silt–clay content at Stations B10 and B9 was >83%, with higher levels of fine sand than at the other Group B stations. Both the Group C stations (B4 and B2) had a silt content of >82%, but they also contained quantities of fine sand, medium sand and even some coarse sand which gave a slightly coarser substrate type than in Group B. Group D linked to Groups B and C at a slightly lower similarity level. These stations contained >91% silt–clay with <1% coarse material. Their high silt content separated them from the other two groups.

Table 3 summarises the results of the faunal analysis from the ten stations sampled in the Bantry Harbour area. A total of 53 families with 742 individuals were identified. Of the 53 families identified, 21 were Polychaeta, 6 Bivalvia, 7 Gastropoda, 3 Echinodermata, and 16 Crustacea. Values of the Shannon–Weiner diversity index ranged from 1.46 at Station B5, which had the lowest number of families, to 2.58 at Station B4. Values of evenness ranged from 0.70 at Station B5 (uneven distribution) to 0.93 at Station B6 (even distribution). Species richness ranged from 1.88 at Station B5 (lowest number of families) to 5.57 at Station B8 (highest number of families and individuals).

The results of the classification analysis are presented in dendrogram form in Figure 3.

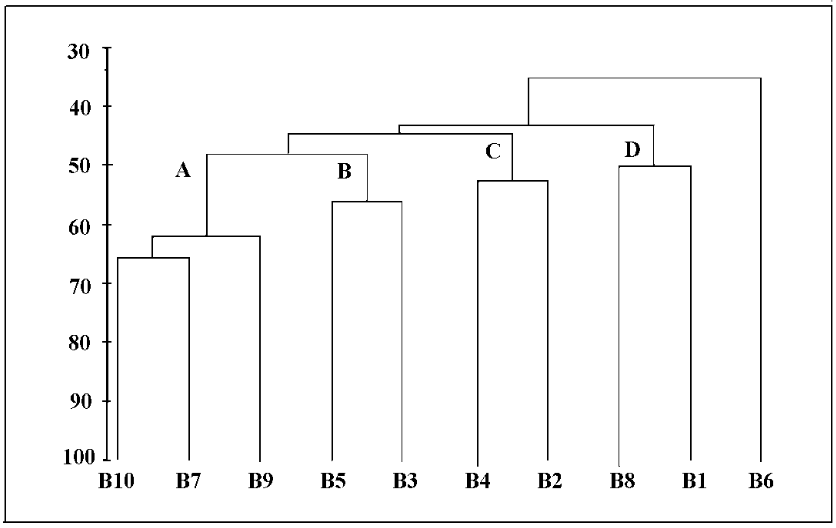

Fig. 3. Results of the classification analysis of the faunal data from Bantry Harbour.

Four station clusters can be identified:

Group	Station
A	B7, B9, B10
B	B3, B5
C	B2, B4
D	B1, B8

Station B6 was dissociated.The member stations of each group fused together at relatively high levels of similarity. Group B was joined to Group A but at a much lower similarity level. Groups C and D joined these at increasing levels of dissimilarity. Station 6 was dissociated, joining onto the other stations at a very low level of similarity.

Classification analysis of the families identified ten clusters (Figure 4). The member families of these groupings (labelled Groups 1 – 10) are given in Table 4, in which the station groupings are also defined, producing a two-way co-incidence table.

Family Group 4, the largest, was composed of families that were present at most stations and can be subdivided into:

4a – families occurring at most stations but in low numbers;
4b – families occurring abundantly at most stations.

Group 1 comprised families found only at Station B8; Group 2 contained families found only at Station Group C (B2, B4); Group 3 contained families found at Station B9; families found in Station Group A (B10, B7, B9) cluster in family Group 5; Group 6 contained families from Station B4; families found only at Station B1 occurred in Group 7; two families found only at Station B7 comprised family group 8; Group 9 contained families only occurring at Station B2; Group 10 comprised of families having single occurrences at Station B3.

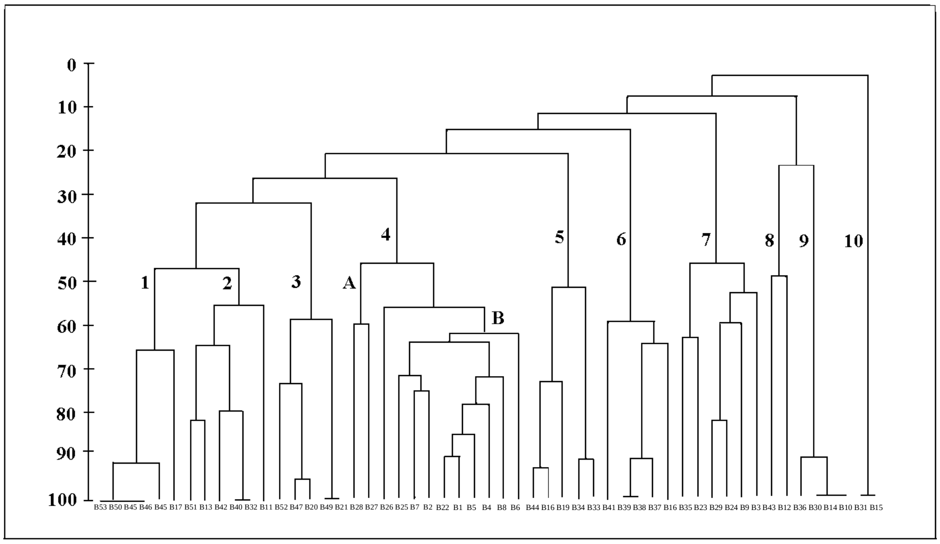

Fig. 4. Results of the classification analysis of the families from Bantry Harbour.

Comparison of the sediment and faunal groupings resulting from classification analysis reveals an almost identical station composition. This reinforces the correlation between benthic communities and sediment distribution.

Station B6, which was dissociated, had the least number of individuals and a correspondingly small number of families. The fauna consisted of a low abundance of a few families, which gave a high evenness value. The sediment here had a very high silt content (95%) and appeared anoxic.

Group A stations (B10, B7 and B9) were located south of Chapel Island. All three had a high silt content (>90%) with no coarse material. The sediment appeared black and anoxic. These stations had a very similar faunal composition composed mainly of the commonly occurring families (Table 4).

There were no crustaceans or echinoderms recorded from the Group B stations (B5 and B3) and only one gastropod. The number of families was low but there was a relatively high number of individuals. Cirratulid polychaetes and Scrobicularid bivalves dominated, the other families had low abundances. Sediments had a high silt content with no coarse material.

A very high number of families and individuals were recorded from the Group C stations (B2 and B4). This produced correspondingly high values of diversity, richness and evenness. Several families had their greatest abundances at these stations, including Amphiuridae (Echinodermata), Harpacticoida (Crustacea), Scrobicularidae (Bivalvia) and Sigalionidae (Polychaeta). In fact, the highest numbers of both echinoderms and crustaceans were recorded from this group. The silt content of the sediment was high with relatively high organic carbon values also.

Group D (stations B8 and B1) had high numbers of families and individuals. Several polychaetes occurred in high abundances, e.g. Spionidae, Syllidae and Cirratulidae. Bivalves, however, were scarce. Serpulid polychaetes and several crustaceans had their only occurrences at these stations. The highest number of Crustacean families was recorded at Station B8. The sediment was much coarser at these stations than elsewhere in the Bantry Harbour area, with gravel being recorded at both stations.

Polychaetes dominated the faunal assemblages in the Bantry Harbour area. From a total faunal count of 742 individuals, 427 were polychaetes. They were the most commonly distributed organisms with many families occurring at all stations, most in fairly consistent densities. While the abundances of the majority of bivalve families was low, the Scrobicularidae (mostly *Abra alba*) occurred at all stations in relatively high densities, accounting for 139 individuals of the total bivalve count of 198. Diversity levels were not very high but the population was comparatively evenly distributed throughout. This, coupled with the low abundances could be indicative of unstable conditions.

The sole occurrences of Serpulid polychaetes and several crustacean families at the Group D stations and their absence from the other stations may be attributed to the coarser nature of the substrates. Crustaceans prefer less silty substrates while Serpulids, having a sedentary lifestyle, construct a calcareous tube attached to rocks and stones, etc. Thyasiridae occurred in relatively high abundance although the actual numbers were not large. The occurrence in high densities of these bivalves is usually indicative of sub-normal conditions. Although echinoderm numbers were low they were present at several stations and had relatively high occurrences at Station B2.

Glengarriff Harbour

Table 5 presents the results of the granulometric analysis, with each sample being assessed in terms of its percentage gravel, coarse sand, medium sand, fine sand and silt–clay content. Organic carbon analysis results from three stations are also shown. The values ranged from 1.69% at G5 to 2.85% at G2.

Results from classification analysis of the granulometric data are graphically presented in Figure 5. Two station groupings were identified:

Group	Station
A	G1, G3
B	G2, G5

Station G4 was dissociated.

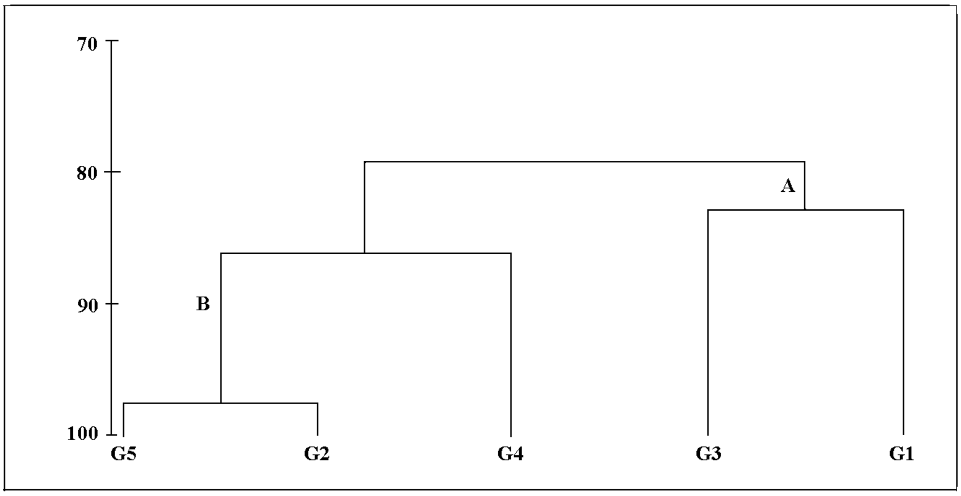

Fig. 5. Results of the classification analysis of the granulometric data from Glengarriff Harbour.

Group A stations contained no coarse material. The fine sand/silt–clay content accounted for 99.9% of the sediment. The granulometric composition of the two stations in Group B was almost identical and both had a >94% silt–clay content. Station G4 links onto Group B but at a lower level of similarity. It had a high silt content (87%) but there was also some gravel (5.5%) and coarse sand.

A total of 31 families with 491 individuals were identified from the five stations sampled in the Glengarriff Harbour area (Table 6). Of these 16 were Polychaeta, 4 were Bivalvia, 3 were Gastropoda, 1 was Echinodermata and 7 were Crustacea.

Table 6 lists the values for the community parameters of diversity evenness and species richness. Shannon–Weiner diversity indices ranged from 1.11 at Station G3, which had the highest number of families, to 2.07 at Station G2. Evenness values were between 0.39 (G 3) and 0.92 (G5), going from uneven to evenly distributed communities. Values of species-richness ranged from 1.43 at Station G1 (lowest number of families) to 3.29 at Station G3 (highest number of families).

Classification analysis identified one main station cluster (Stations G2, G3 and G4), with the remaining two stations (G5 and G1) joining this group at very low levels of similarity. This is graphically represented in Figure 6.

The results of classification analysis of the families identified five family clusters (Figure 7). The member families (labelled Groups 1–5) are listed in Table 7 along with the station groupings in the form of a two-way co-incidence table.

Family Groups 1 and 5 were joined to the other groups at a lower level of similarity. Group 3 contained the commonly occurring families and can be subdivided into:

- 3a – families found only at the grouped stations (G4, G2 and G3) and not at either G1 or G5;
- 3b – families found at all stations except G1;
- 3c – families occurring at all stations in relatively high numbers.

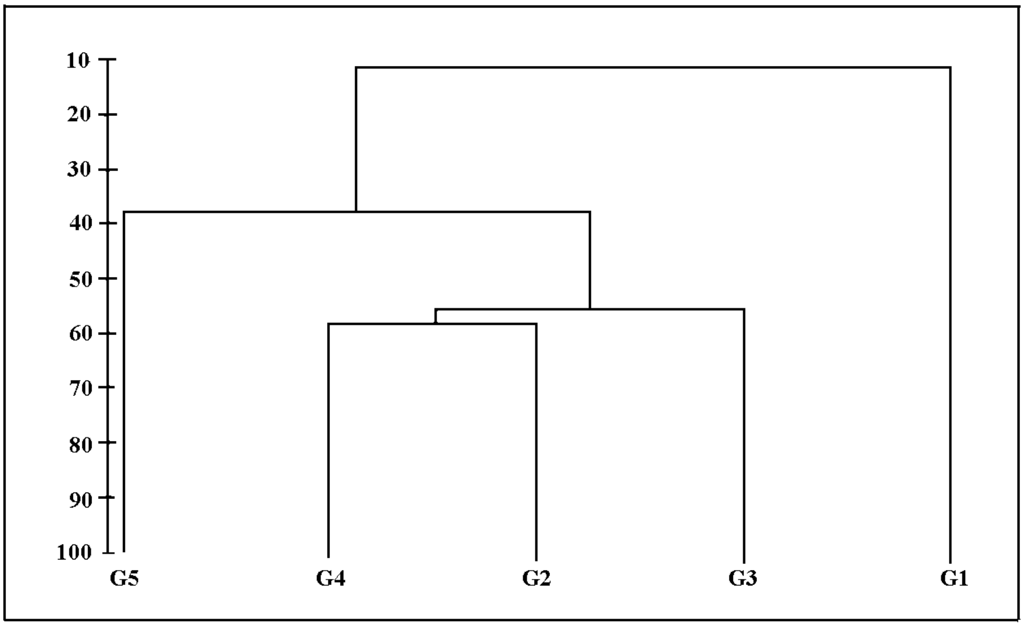

Fig. 6. Results of the classification analysis of the faunal data from Glengarriff Harbour.

Group 1 contained families found only at Station G5; families occurring solely at Station G2 are in Group 2; Group 4 contained families occurring at Stations G4 and G3 but not G2; Group 5 was composed of families only found at Station G1.

Three stations (G2, G3 and G4) were grouped together in the results of classification analysis. They shared a very similar faunal composition (Table 7) having large numbers of families and individuals compared to the other two stations. A few families with high abundances, most notably the Cirratulids (Polychaeta), which occurred in large quantities, dominated the group. The lowest number of individuals was recorded at Station G5 with a correspondingly low number of families. The faunal composition was very similar to that of the three-station group but at much lower densities, having just one or two individuals of each family which gave a very evenly distributed population. The size of the sample taken here was quite small. Although dissociated, Station G5 was linked to the triplet group, albeit at a much lower level of similarity. The only echinoderm (one individual Amphiuridae) of the survey was found here. There were no crustaceans recorded at this station.

The results of classification analysis showed that Station G1 linked to the other four stations at a very low level of similarity. Further evidence of this separateness is seen in Table 7, where Family Group 3b contains families occurring at all stations except G1 while Group 5 was composed of families only found at this station. Station G1 had the lowest number of families, with most represented by just one or two individuals. The exception was juvenile polychaete Nephtydidae, with a density of 20 individuals/0.05 m^2. This juvenile polychaete occurred only at this station, totally dominating the fauna, but no adults were recorded. Adult Nephtydidae were recorded at all other stations. The only other occurrence of note was the Pyramidellid gastropod with 8 individuals/ 0.05 m^2. None of the families, which were abundant at the other stations, occurred here. There was

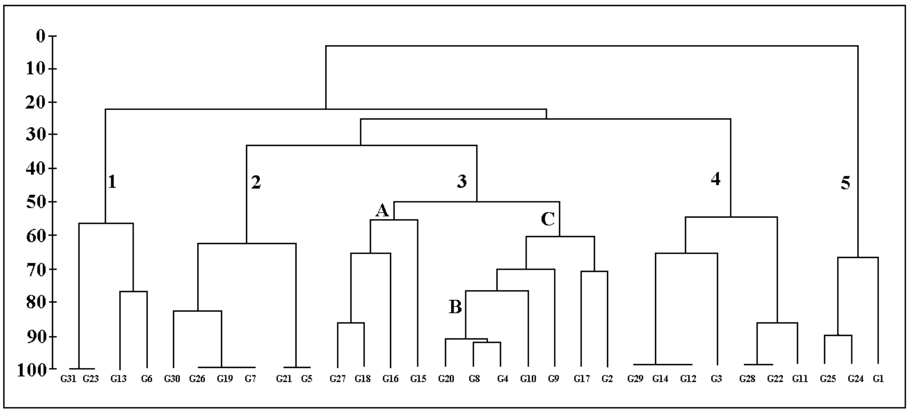

Fig. 7. Results of the classification analysis of the families from Glengarriff Harbour.

a high silt/fine sand content, but nothing coarser and the sediment had a black anoxic appearance and smelled strongly of sulphur.

As was the case in the Bantry Harbour area, the faunal community in Glengarriff Harbour area was totally dominated by polychaetes and mainly one family, the Cirratulids. Polychaetes accounted for 390 individuals from a total faunal count of 491 individuals, of which 244 were Cirratulids. A few other polychaete families (e.g. Spionidae, Nephtydidae) occurred in relatively high numbers but otherwise abundances were quite low. These three families are also considered as indicative of increased organic enrichment. Such abundances compared to the low numbers of other families and the general dominance by polychaetes can be taken as evidence of stressed conditions.

Whiddy Island

Table 8 presents the results of the granulometric analysis, with each sample being assessed in terms of its percentage gravel, coarse sand, medium sand, fine sand and silt–clay. Values of organic carbon ranged from 1.78% at Station W3 to 5.67% at Station W1.

Cluster analysis (Figure 8) grouped Stations W2 and W1 together at a high similarity level, with Station W3 linked on a much lower level of similarity. Stations W2 and W1 both contained relatively high amounts of coarser material, whereas Station W3 had a 98% fine sand content with no coarse material.

Forty-seven families, with 461 individuals, were identified from the three stations sampled in the vicinity of Whiddy Island (Table 9). Of these 23 were Polychaeta, 8 Bivalvia, 4 Gastropoda, 2 Echinodermata and 10 Crustacea. The community parameters of diversity, evenness and species-richness are listed in Table 9. The Shannon–Weiner diversity index ranged from 2.22 at Station W3, which had the highest number of individuals, to 2.57 at Station W1 which had the highest number of families. Evenness values ranged from 0.70 at Station W3 (relatively uneven distribution) to 0.91 at Station W2 (even distribution). Species-richness ranged in value from 3.60 at Station W2 (lowest number of families) to 5.73 at Station W1 (highest number of families).

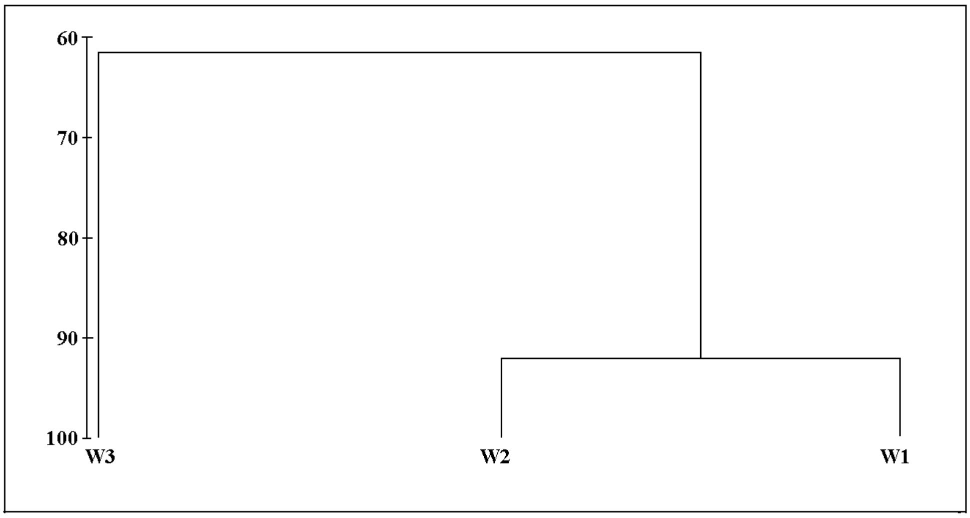

Fig. 8. Results of the classification analysis of the granulometric data from Whiddy Island.

Classification analysis showed that Stations W3 and W1 join at a fairly high similarity level with Station W2 linked to this couplet at a much lower level of similarity (Figure 9).

Classification analysis of the families defined five family clusters (Figure 10). The member families of these groups are given in Table 10 (labelled Groups 1–5).

Group 3 contained the commonly occurring families with high abundances and can be subdivided to give:

Group 3a – families at all stations in high numbers;

Group 3b – families at Stations W3 and W1 in high numbers but not found at Station W2.

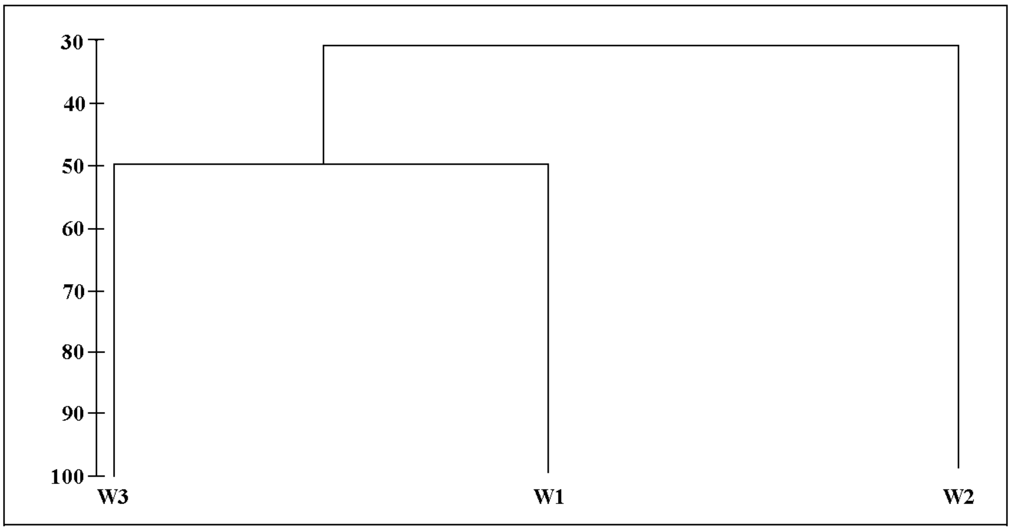

Fig. 9. Results of the classification analysis of the faunal data from Whiddy Island.

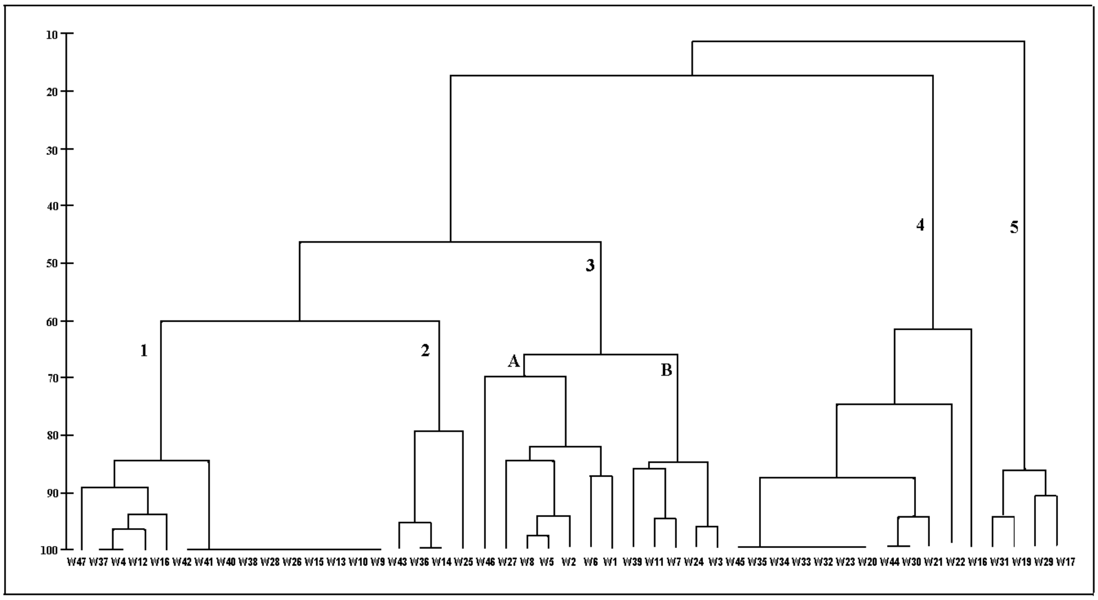

Fig. 10. Results of the classification analysis of the families from Whiddy Island.

Family Group 1 contained families found only at Station W1; families occurring at Stations W1 and W2 but not at W3 were found in Group 2; Group 4 was composed of families occurring only at Station W3; Group 5 contained families only found at Station W2. Groups 4 and 5 were joined to the other groups at a much lower level of similarity.

Classification analysis shows Stations W1 and W3 joined together on the dendrogram at a median level of similarity, with Station W2 linked at a much lower level. Stations W1 and W3 had high abundances of families and individuals. Although W2 had a similar faunal composition the densities were much lower.

Substrates at Station W2 were coarser with a greater gravel content than elsewhere. The population was evenly distributed with no one family dominating. Crustacean numbers were higher here than at the other stations, whereas echinoderms, which were abundant elsewhere, were not recorded at Station W2. Serpulid polychaetes had their sole occurrence here in relatively high numbers. Table 10 shows families occurring only at Station W2 in Group 5, while Group 3b comprised families having high abundances at the other two stations but not occurring at W2.

Rich faunal densities were recorded at Stations W1 and W3 with a considerable number of families represented (Table 10). Quite high abundances of Amphiuridae (Echinodermata) were recorded here whereas none occurred at Station W2. The mud-loving Scrobicularidae (Bivalvia) dominated the fauna at Station W3, but occurred in lesser densities elsewhere. Station W3 was predominately silty but Station W1 has much coarser bottom substrates.

Discussion

Data presented in Barry *et al.* (1988) show that current speeds in the Bantry Harbour area and in Glengarriff Harbour are weak, typically <10 cm/s. The weak currents and sheltered nature of both locations indicate that they are both non-dispersive sites where fine material may accumulate. This is borne out by the granulometric data collected in this study which clearly showed that the sediments in these areas are comprised mainly of particles <63 µm with very little coarse material. In contrast the sediments collected close to the north shore of Whiddy Island contained relatively high amounts of medium and coarse sand.

Fluctuations in organic input are considered to be one of the principal causes of faunal change in near-shore benthic environments. Increased organic enrichment results in changes in physical and biological parameters, which in turn have effects on the sedimentary and biological structure of an area. The number of suspension-feeders (e.g. echinoderms and crustaceans) declines and deposit-feeders (e.g. opportunistic polychaetes) increase as organic input to the sediment increases (Pearson and Rosenburg, 1978).

The initial stages of recovery from enrichment and the last stages to survive following excessive organic input are similar. Between the afaunal point and the 'normal' community three successional stages are defined:

(1) The peak of opportunists, where there are only a few species in great numbers;
(2) The ecotone point, where abundance is low and evenness and diversity high;
(3) The transition zone with fluctuating populations progressing towards the more stable 'normal' community.

In the Bantry Harbour area, cirratulid polychaetes, which can be considered as opportunistic, occur in high densities across the study area. Despite the occurrence of echinoderms, especially Amphiuridae which are very sensitive to increased organic enrichment, when viewed as a whole this area appears to be in an intermediate phase between slight environmental stress and broadscale pollution.

The benthic community in Glengarriff Harbour also appears to be at a transitory phase or ecotone point between normal and polluted conditions. This is further emphasised by the absence (except for one individual) of echinoderms from the study area. The absence of several families from Station G1, which are present at the others, suggests that this station experiences even more stressed conditions. In fact, the juvenile Nephtydidae at Station G1 may be playing an opportunistic role in the absence of other dominant species. This, coupled with the dominance of polychaetes in general and Cirratulids in particular, is indicative of stressed environmental conditions.

Since the first experimental raft was installed in 1982 Bantry Bay has become one of the main mussel(*Mytilus edulis*)-producing areas in the country, and the mussel resource represents the single most valuable harvest from the bay at present. The main mussel-growing area in inner Bantry Bay is the Bantry Harbour area to the east of Whiddy Island with some longlines also along the eastern and western sides of Glengarriff Harbour. Previous studies (e.g. Dahlback and Gunnarsson, 1981; Tenore *et al.*, 1982, 1985; Mattsson and Lindal, 1983; Kaspar *et al.*, 1985; Kautsky and Evans, 1987) have shown that mussel culture produces accumulations of faeces and mussels under the longlines which effectively increases organic enrichment. This can lead to a decrease in the diversity of the infaunal assemblages with the original macrofauna (especially echinoderms) being replaced by opportunistic polychaetes. The dominance of polychaetes noted during this study cannot, however, be totally ascribed to the impacts of mussel production. Polychaete dominance was noted at stations directly underneath mussel longlines (e.g. Stations B6, B3) as well as at stations not in the vicinity of longlines (e.g. G1, B5, B10). Inputs of organic matter to inner Bantry Bay come from domestic and industrial waste discharges and natural sources as well as from mussel production. The relative inputs from all the sources have, however, not been quantified.

All three stations sampled off the northern shore of Whiddy Island exhibited a very healthy faunal composition. While polychaete numbers were higher than other phyla, they did not excessively influence the faunal assemblages. Abundances were fairly evenly distributed with no one family predominating. Cirratulid polychaetes only occurred at one site (W1) at very low numbers. High numbers of amphiuroid echinoderms were recorded from these sampling stations. Echinoderms are never found in polluted or even transitory conditions; thus, their presence is a good indication of a stable, unstressed environment. The absence of echinoderms from Station W2 can be attributed to the coarser sedimentary conditions prevailing there, which are not preferred by the suspension feeders. These coarse substrates also account for the sole occurrence at W2 of serpulid polychaetes. There does not appear to be any residual effect from the explosion of the oil tanker "*Betelgeuse*" in 1979.

Compared to the healthy status of stations on the northern side of Whiddy Island, the stations to the east, in Bantry Harbour as well as in Glengarriff Harbour, showed evidence of environmental stress. An increase in the organic loading to these areas may lead to a further deterioration in benthic conditions with a consequent shift in successional stage.

The data presented in this report provide a valuable "baseline" against which future changes in the benthos can be assessed. It is recommended that further surveys of the benthos in inner Bantry Bay be carried out and that the inputs of organic matter to the area be quantified.

Acknowledgements

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Table 1. Location of sampling stations in inner Bantry Bay, February 1993

Station	Location	Latitude (N)	Longitude (W)	Depth (m)
B1	Bantry Harbour	51º42.35'	09º28.63'	10
B2		51º42.38'	09º28.00'	15
B3		51º41.90'	09º27.83'	15
B4		51º41.72'	09º27.70'	10
B5		51º41.45'	09º27.50'	10
B6		51º41.35'	09º28.22'	10
B7		51º41.32'	09º28.73'	6
B8		51º41.49'	09º28.76'	6
B9		51º41.15'	09º29.15'	8
B10		51º40.85'	09º27.95'	10
G1	Glengarriff Harbour.	51º44.92'	09º32.42'	4
G2		51º44.55'	09º31.90'	10
G3		51º44.07'	09º31.90'	10
G4		51º43.92'	09º32.82'	10
G5		51º42.95'	09º32.44'	20
W1	Whiddy Island	51º41.34'	09º31.53'	25
W2		51º41.83'	09º30.53'	15
W3		51º42.37'	09º29.19'	20

Table 2. Results of the physico–chemical analysis of the sediments from Bantry Harbour

Station	% gravel (4–2 mm)	%Coarse Sand (1.4 mm–500 µm)	%Medium Sand (355–250 µm)	%Fine Sand (180–63 µm)	%Silt Clay (<63 µm)	%Organic Carbon
B1	49.0	25.6	9.0	11.0	5.4	2.67
B2	1.1	2.7	3.2	10.9	82.1	2.02
B3	0.4	1.7	1.5	6.7	89.7	
B4	1.1	3.6	2.7	3.7	88.9	1.95
B5	0.0	0.5	0.5	2.4	96.6	1.92
B6	0.1	0.6	0.4	3.1	95.8	
B7	0.2	1.8	1.0	6.0	91.0	
B8	10.8	8.6	4.8	11.2	64.6	2.50
B9	0.3	2.0	1.4	12.6	83.7	1.62
B10	0.2	0.8	1.0	8.5	89.5	1.79

Table 3. Community parameters for samples taken in Bantry Harbour

Station	No. Families	No. Individuals	Diversity	Evenness	Richness
B1	14	85	2.27	0.86	2.93
B2	17	113	2.04	0.72	3.38
B3	13	45	2.36	0.92	3.15
B4	25	109	2.58	0.80	5.12
B5	8	41	1.46	0.70	1.88
B6	11	22	2.22	0.93	3.24
B7	11	48	2.04	0.85	2.58
B8	28	127	2.53	0.76	5.57
B9	18	67	2.39	0.83	4.04
B10	13	85	2.26	0.88	2.70

Table 4. Member families of the groupings identified from classification analysis of the faunal data in samples from Bantry Harbour

Group	Family	Code	B10	B7	B9	B5	B3	B4	B2	B8	B1	B6
	Sparangidae	4	0	0	0	0	0	0	0	1	0	0
	Gammaridae	5	0	0	0	0	0	0	0	1	0	0
	Caprellidae	5	0	0	0	0	0	0	0	1	0	0
1	Diastylidae	5	0	0	0	0	0	0	0	1	0	0
	Haustoriidae	5	0	0	0	0	0	0	0	2	0	0
	Polynoidae	1	0	0	0	0	0	0	0	1	0	1
	Amphiuridae	4	0	0	0	0	0	2	24	1	0	0
	Heisonidae	1	0	0	0	0	0	2	1	2	0	0
2	Nannostacidae	5	0	0	1	0	0	1	0	1	0	0
	Ostracode (ind.)	5	0	0	0	0	0	1	0	1	0	0
	Rissodiae	3	0	0	0	0	0	1	0	1	0	0
	Scalibregmidae	1	0	0	0	2	3	1	2	1	0	0
	Ophiolepidae	4	0	0	1	0	0	0	1	3	0	0
	Bodotriidae	5	0	0	1	0	0	0	0	1	0	0
3	Maldanidae	1	0	0	2	0	0	0	0	1	0	0
	Cumacea (ind.)	5	0	0	2	0	0	0	0	0	0	0
	Poly. Indet.	1	0	0	2	0	0	0	0	0	0	0
	Pyramidellidae	3	3	0	2	0	0	3	1	0	0	6
	Corbulidae	2	0	0	1	1	0	1	0	0	0	2
4a	Thyasiridae	2	5	2	2	2	1	4	0	0	0	0
	Nuculidae	2	0	2	3	0	2	8	6	1	0	2
	Ampharetidae	1	5	9	6	0	5	8	0	1	2	2
	Glyceridae	1	0	0	1	0	4	5	0	1	1	1
	Scrobicularidae	2	15	11	16	10	6	23	33	4	17	2
	Nephtydidae	1	10	8	11	2	4	6	10	6	5	2
4b	Cirratulidae	1	11	4	3	21	8	3	1	19	4	1
	Spionidae	1	8	0	1	2	3	7	6	20	20	0
	Syllidae	1	18	8	11	0	0	1	1	33	5	0
	Sigalionidae	1	0	0	1	0	1	1	19	5	3	0
	Amphipoda ind.	5	2	1	0	0	0	0	0	8	0	0
	Terebellidae	1	2	1	0	0	0	0	0	2	0	0
5	Phyllodocidae	1	3	0	0	0	0	0	0	1	0	0
	Naticidae	3	1	0	0	0	0	0	0	0	0	0
	Cerithidae	3	2	0	0	0	0	0	0	0	0	0
	Harpacticoida L	5	0	0	0	0	0	24	0	0	0	0
	Isopoda (ind.)	5	0	0	0	0	0	1	0	0	0	0
6	Munnidae	5	0	0	0	0	0	1	0	0	0	0
	Phoxocephalidae	5	0	0	0	0	0	2	0	0	0	0
	Nephtydidae juv.	1	0	0	0	1	0	1	0	0	0	0
	Gammaridea (ind.)	5	0	0	0	0	0	0	0	0	1	1
	Mytilidae	2	0	0	0	0	6	0	0	0	5	2
7	Gastrop. (ind.)	3	0	0	0	0	0	0	0	0	4	0
	Cardiidae	2	0	0	0	0	0	0	0	0	1	0
	Dorvillidae	1	0	0	0	0	0	1	0	0	9	0
	Serpulidae	1	0	0	0	0	0	0	0	7	8	0
8	Calliopiidae	5	0	1	0	0	0	0	0	0	0	0
	Lumbrineridae	1	0	1	0	0	0	1	1	0	0	0
	Pycnogonida	5	0	0	0	0	0	0	2	0	0	0
9	Nassaridae	3	0	0	0	0	0	0	1	0	0	0
	Paraonidae	1	0	0	0	0	0	0	1	0	0	0
	Flabelligeridae	1	0	0	0	0	0	0	1	0	0	0
10	Retusidae	3	0	0	0	0	1	0	0	0	0	0
	Pilargiidae	1	0	0	0	0	1	0	0	0	0	0

Table 5. Results of the physico–chemical analysis of sediments from Glengarriff Harbour

Station	% gravel (4–2 mm)	%Coarse Sand (1.4 mm–500 µm)	%Medium Sand (355–250 µm)	%Fine Sand (180–63 µm)	%Silt Clay (<63 µm)	%Organic Carbon
G1	0.0	0.0	0.0	11.9	88.1	
G2	0.1	0.8	1.0	4.0	94.1	2.85
G3	0.0	0.0	0.1	0.9	99.0	
G4	5.5	1.3	1.0	4.4	87.7	2.35
G5	0.0	0.8	1.2	3.2	94.8	1.69

Table 6. Community parameters for samples taken in Glengarriff Harbour

Station	No. Families	No. Individuals	Diversity	Evenness	Richness
G1	6	33	1.13	0.63	1.73
G2	16	113	2.07	0.75	3.17
G3	17	129	1.11	0.39	3.29
G4	14	198	1.82	0.69	2.46
G5	9	18	2.01	0.92	2.77

Table 7. Member families of the groupings identified from classification analysis of the faunal data from Glengarriff Harbour

Group	Family	Code	G5	G4	G2	G3	G1
1	Amphiuridae	4	1	0	0	0	0
	Nuculidae	2	1	0	0	0	0
	Magelonidae	1	2	0	0	1	0
	Phyllodocidae	1	1	0	1	1	0
2	Harpacticoida	5	0	0	4	0	0
	Dexaminidae	5	0	0	1	0	0
	Gastrop. Indet	3	0	0	1	0	0
	Sigalionidae	1	0	0	1	0	0
	Mytilidae	2	0	0	3	1	0
	Glyceridae	1	0	0	3	1	0
3a	Bodotriidae	5	0	12	1	0	0
	Buccinidae	3	0	2	1	0	0
	Terebellidae	1	0	4	0	0	0
	Scalibregmidae	1	1	22	0	0	0
3b	Scrobicularidae	2	3	20	9	3	0
	Spionidae	1	1	7	11	4	0
	Nephtydidae	1	4	6	6	6	0
3c	Dorvillidae	1	0	3	14	1	0
	Cirratuludae	1	4	98	42	100	0
	Pyramidellidae	3	0	6	14	0	8
	Syllidae	1	0	9	1	1	1
4	Leucothoidae	5	0	0	0	1	0
	Flabelligeridae	1	0	0	0	1	0
	Polynoidae	1	0	0	0	1	0
	Pilargiidae	1	0	0	0	1	1
	Phoxocephalidae	5	0	1	0	2	0
	Thyasiridae	2	0	1	0	2	0
	Ampharetidae	1	0	7	0	2	0
5	Cumacae Indet.	5	0	0	0	0	2
	Gammaridae Indet.	5	0	0	0	0	1
	Nephtydidae juv.	1	0	0	0	0	20

Table 8. Results of the physico–chemical analysis of sediments from Whiddy Island

Station	% gravel (4–2 mm)	%Coarse Sand (1.4 mm–500 µm)	%Medium Sand (355–250 µm)	%Fine Sand (180–63 µm)	%Silt Clay (<63 µm)	%Organic Carbon
W1	3.2	36.1	24.2	12.3	24.2	5.67
W2	10.9	35.5	10.0	11.1	32.5	2.53
W3	0.2	0.5	0.7	9.6	89.0	1.78

Table 9. Community parameters for samples taken at Whiddy Island

Station	No. Families	No. Individuals	Diversity	Evenness	Richness
W1	31	187	2.57	0.75	5.73
W2	15	49	2.45	0.91	3.60
W3	24	225	2.22	0.70	4.25

Table 10. Member families of the groupings identified from classification analysis of the faunal data from Whiddy Island

Group	Family	Code	W3	W1	W2
1	Ophiolepidae	4	0	7	0
	Bodotriidae	5	0	3	0
	Cirratulidae	1	0	3	0
	Maldanidae	1	0	4	0
	Sabellidae	1	0	2	0
	Caprellidae	5	0	1	0
	Pycnogonida	5	0	1	0
	Diastylidae	5	0	1	0
	Ingolfiellidia Indet.	5	0	1	0
	Retusidae	2	0	1	0
	Mytilidae	2	0	1	0
	Goniadidae	1	0	1	0
	Sabellidae	1	0	1	0
	Syllidae	1	0	1	0
	Oweniidae	1	0	1	0
2	Haustoriidae	5	0	1	1
	Ostracoda Indet.	5	0	1	2
	Amphictenidae	1	0	1	2
	Corbulidae	2	0	13	1
3a	Amphiuridae	4	28	64	0
	Scrobiculariidae	2	83	6	1
	Sigalionidae	1	17	16	4
	Spionidae	1	17	16	2
	Scalibregmidae	1	26	11	5
	Lumbrineridae	1	4	4	7
	Gylceridae	1	1	9	3
3b	Amphipoda Indet.	5	2	1	0
	Magelonidae	1	1	3	0
	Terebellidae	1	1	6	0
	Thyasiridae	2	10	3	0
	Ampharetidae	1	6	3	0
4	Cumacea Indet.	5	1	0	0
	Trochidae	3	1	0	0
	Rissoidae	3	1	0	0
	Pyramidellidae	3	1	0	0
	Muricidae	3	1	0	0
	Nephtydidae juv.	1	1	0	0
	Pilargiidae	1	1	0	0
	Phoxocephalidae	5	3	0	0
	Nuculidae	2	3	0	0
	Hesionidae	1	2	0	0
	Flabelligeridae	1	10	0	0
	Nephtydidae	1	4	0	1
5	Cardiidae	2	0	0	2
	Phyllodocidae	1	0	0	3
	Veneridae	2	0	0	5
	Serpulidae	1	0	0	10